Chapter 5 RECOMMENDATIONS

It is beneficial to the State of California and its affiliated agencies and environmental interest groups to consider standardization and methods consistency of bioassessment and biomonitoring throughout its vast watershed network. The benefits include data sharing, conformity in evaluating ecological status, implementation of scientifically based management decisions, maximizing limited technical resources, statewide calibration of biological indicators, and broadscale application and linkage to regulatory activities. From a technical standpoint, the endorsement of consistent methods will provide development of a statewide reference condition and indicator calibration that will, in turn, provide cost efficiencies and enhance program effectiveness for watershed protection and restoration goal-setting.

Our recommendations are structured into areas such as (1) candidate methods, (2) replication, (3) reference condition, (4) calibration of biological indicators, (5) physical habitat assessment, (6) database management, and (7) institutional/policy issues.

5.1 Candidate Methods

Of the five candidate methods, the CSBP is the most widely used throughout the state. Data from multiple collections at more than 2500 sites are available from streams throughout California. A method similar in performance to the CSBP is that developed by SNARL. While the sampling precision of the SNARL method is somewhat more robust than that of the CSBP, both methods are similar enough in results to be considered equally effective in assessing biological condition. Both methods, and those of most of the other candidate programs, focus on cobble substrate (i.e., riffle habitat) as the primary habitat type for collection. It is generally thought by stream ecologists that the riffle habitat is the most productive habitat, where present, and that the macroinvertebrate assemblage of the riffle or other cobble substrate contains the most diverse and sensitive fauna with respect to water quality. Both EMAP and NAWQA methods have endorsed a more multihabitat approach that accounts for techniques that are more representative of stream reach characteristics, and not just site-specific conditions relevant to a single riffle. We recommend that a multihabitat feature be added to the methods to enable a more pertinent evaluation of multiple stressors, such as both chemical (water quality) and non-chemical (habitat-induced) perturbations. Adding a multihabitat component may be in the form of the EMAP method or the NAWQA Qualitative Multihabitat method, or even a variation of the CSBP method to enable advancement to current methodologies rather than radical modifications. Current collaborative efforts between CSBP and EMAP lend themselves to adopting an EMAP sampling methodology. The important aspect of method development is to maintain continuity and data integrity of existing ecological data as methods refinement is adopted into a water resource program. This can be done, in the simplest of techniques, by documenting the biological condition of sites and prioritizing along a disturbance gradient. Changes in condition from one method to another are evaluated for influential factors related to methods changes. Specific considerations for adopting a multihabitat approach are to provide a framework for characterizing regional reference conditions that are parceled out from a statewide network of candidate reference sites, and to enable a characterization of natural variability associated with a

composite of habitat types expected to be present in California streams.

5.2 Replication

For bioassessment purposes, replication is important to identify the performance characteristics, namely sampling precision, of a method, and to strengthen a judgment of the biological condition of a site where uncertainty exists from the results. Most state water resource agencies follow a sequential decision process whereby a composited sample (i.e., composited from a variety of habitats or microhabitats within a habitat) from a method with known precision is used to assess the biological condition. If the results indicate that the judgment of biological condition may be in error because the precision of the method is insufficient, then additional data or other information is needed to confirm the assessment. Therefore, replication, albeit considered pseudoreplication by most biostatisticians, is needed at sites where judgment of biological condition is contentious or uncertain and also to establish precision estimates of the method and investigators. The collection of replicates as a routine procedure is a good practice, but cost considerations may prevent a wide scale implementation of such a procedure. At a minimum, 10% of collections should be replicated. Furthermore, sites that are likely to be in the intermediate portion of the biological condition gradient (i.e., neither considered of reference caliber nor severely impaired status) would benefit from replication, depending on the precision of the method. The exact number of replicates should be decided by a technical workgroup. Factors to be considered are overall objectives and cost implications. Most states take duplicates (Barbour et al. 1999) because the objective is method precision, and two replicates are all that are needed. A precedent has been established in California for three and five replicates (CSBP and SNARL, respectively) to be taken. Our analyses indicate that the two techniques are relatively similar and that cost implications may be a factor. We recommend that replication be continued in California bioassessments for the purpose of precision estimates. We also support a reduction in replicates to two or three as a compromise between statistical power and cost.

5.3 Reference Condition

Regardless of methods, either the identification of candidate reference sites or the elimination of degraded stream reaches from consideration as reference should be possible from the volume of data acquired from around the state in the various monitoring programs. Compilation of the locations and watersheds that contain candidate reference sites can be used as a basis to conduct a land use characterization that will detail the extent of potential disturbance from human activities. Once these candidate sites are delineated on maps and land use overlays, data gaps should be identified and addressed. Data gaps would also include an identification of the kind of methods and collecting techniques. For this subsequent step, only biological data from consistent methods can be used to avoid introducing sampling bias in the results. It may be necessary to schedule some targeted sampling to procure the comparable data. The reference condition is the expected or best idea of the structure and function of the aquatic community, and it also reflects a partitioning of the natural variability into homogeneous classes or groups. This analysis is usually done via multivariate analyses. The DFG-ABL and SNARL are collaborating in an effort to identify and characterize reference sites in California. This effort is extremely important for establishing a benchmark for bioassessments. We recommend that the SWRCB interact closely with DFG-ABL and SNARL and consider evaluating its extensive ecological

database to proceed with characterizing reference conditions.

5.4 Calibration of Biological Indicators

Through the endorsement of a statewide database (i.e., CCAMP), SWRCB is compiling all available and viable biological data. The centralization of biological data through this process will provide a means to reconcile differences in certain technical issues, such as sampling and sample processing documentation practices, taxonomic discrepancies, and metric or biological attributes used in different indices. Of particular interest to calibrating a statewide indicator is the CSBP data, which comprise over 8000 data points. The refinement of existing biological indicators can be done using this comprehensive data source. Using a standard of lowest common denominator for methods and level of taxonomy, and following upon the reference condition development, a benthic macroinvertebrate indicator could be developed for use in assessing biological condition and in producing restoration goals for impaired streams. The creation of the California Aquatic Macroinvertebrate Laboratory Network (CAMLnet) was formed in 1995 as a technical advisory body to facilitate the standardization of freshwater macroinvertebrate taxonomy and laboratory procedures. We recommend that the combination of the central database and CAMLnet be used to provide California with a consistent and standard framework for calibrating biological indicators for use on a statewide basis.

5.5 Physical Habitat Assessment

While conducting physical habitat assessments in conjunction with biological assessments is an important feature to any bioassessment program, it is not within the scope of this document to develop any recommendations in regards to physical habitat assessment methods currently used by the candidate programs. It should be noted, however, that further refinements to current physical habitat assessment methods are being explored.

5.6 Database Management

While the CalEDAS database model currently used by DFG works well at the laboratory scale, it will not able to store all the bioassessment data for California. There is, therefore, a strong need for a statewide database of bioassessment data that can accommodate the large quantity of data that will be produced in California. Ongoing statewide efforts of SWAMP, the SWIM II database and the U.S. EPA's STORET database may eventually meet this need, but neither of these is currently ready to handle the bioassessment data. There are currently no provisions for creating a repository for all California bioassessment data. Once a common database is agreed upon (i.e., SWIM II, SWAMP), it is our recommendation that the SWRCB consider appointing a full-time employee to manage the database and provide technical support to database users throughout the State.

5.7 Institutional/Policy Issues

The State of California should decide among the available options for effectively incorporating bioassessment into its water quality regulatory programs (see Section 4.2). Furthermore, the State of California should strive to make funding available for a concerted, statewide bioassessment program. Funding is needed for: (1) establishing a full-time bioassessment coordinator at the SWRCB; (2) ensuring on-going bioassessment sampling and analysis at the RWQCBs; (3) organizing and facilitating workshops where relevant experts can address issues related to taxonomy, tolerance values, reference site selection, standard-setting, etc.; (4) developing and maintaining the capability to conduct GIS exercises to select reference sites; and (5) meeting other common needs such as contracts for refinement of tolerance values and specification of appropriate index periods (see Section 4.3).